ARCL0161
Complexity, Space and Human History

2023–2024, Term 1

15 credits

Co-ordinator: Prof. Mark Lake
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Office hours: Mondays 11:00–13:00 in Room 115

Moodle: https://moodle.ucl.ac.uk/course/view.php?id=39584

The **coursework coversheet** is available on the course Moodle pages and here: https://www.ucl.ac.uk/archaeology/current-students under "Policies, Forms and Guidelines". Please enter your **five-digit candidate code on the coversheet and in the subject line** when you upload your work in Moodle.
Please use your **five-digit candidate code as the name of the file you submit**.
Please refer to
https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment
https://www.ucl.ac.uk/archaeology/current-students/ioa-study-skills-guide/referencing-effectively-and-ioa-guidelines
https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity
https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-AI
for instructions on coursework submission, IoA referencing guidelines and marking criteria, as well asUCL policies on penalties for late submission, over-length work, the use of text generation software (AI) and academic misconduct.

Contents

1 Module overview

1.1 Module description

This course will provide an overview of concepts that are currently proving productive for computationally-oriented approaches to the study of the spatial organisation and long-term unfolding of human history. The course will will cover the application of concepts and methods from complexity science, evolutionary biology and modern spatial analysis to archaeological and historical research—what might broadly be called 'model-based' archaeological and historical science.

The course is taught using a combination of lectures and seminars, and it is assessed through an essay and a computational agent-based model you will have coded yourself. It will particularly benefit those seeking an understanding of the conceptual foundations of modern quantitative and computational approaches to archaeological and historical research.

1.2 Module aims

The aim of the course is to introduce you to a range of contemporary interdisciplinary approaches to the study of the spatial organisation and long-term unfolding of human history. A significant component of this will include developing an understanding of current practice in agent-based modelling as applied to the past. The course will be useful to those seeking an overview of how ideas from complexity science, evolutionary biology and modern spatial analysis can be applied to archaeological and historical research—what might broadly be called 'model-based' archaeological and historical science.

1.3 Learning outcomes

By the end of the course, you will:

- Have acquired an overview of the contemporary disciplinary landscape of 'model-based' archaeological and historical science;
- Have developed an understanding of the principle interdisciplinary concepts that underpin the main strands of contemporary 'model-based' archaeological and historical science;
- Be able to determine which strands of contemporary 'model-based' archaeological and historical science are applicable at particular scales of analysis and to particular facets of reality;
- Understand the importance of robust experimental design in 'model-based' archaeological and historical science;
- Be aware of general issues surrounding the fit between archaeological data and the requirements of the various approaches introduced in the course;
- Be familiar with NetLogo.

1.4 Methods of assessment

The course is assessed entirely by coursework, consisting of two assignments.

	Weighting	Word count	Submission date	Assessment criteria
1. Essay	50%	2500	16th November	Standard
2. Agent-based model	50%	1500	11th January	Special

1.5 Communications

- The Moodle pages are the main hub for this course.
- Important information will be posted by staff in theAnnouncements section of the Moodle page and you will automatically receive an email notification for these.
- Please post any general queries relating to module content, assessments and administrationin theMoodle discussion forum, or via email if you prefer. The forum will be checked regularly.
- For personal queries, please contact the co-ordinator by email.

1.6 Week-by-week summary

The course will be taught in Term 1. The first class will be held on 2nd October and there will be no taught class on 6th November (Reading Week).

Classes will be held on Mondays, commencing at 14:00 and lasting until 16:00. Lectures and seminars will be held in room 322c in the Institute of Archaeology. Practical sessions will be taught in the same room.

Week	Date	Subject
1	2 Oct	Human history and model-based archaeology
2	9 Oct	Complexity
3	16 Oct	Space
4	23 Oct	Human Behavioural Ecology
5	30 Oct	Cultural Evolution and Niche Construction
6	6 Nov	*Reading week*
7	13 Nov	Macroevolution, phylogenetics and the comparative method
8	20 Nov	Agent-based modelling
9	27 Nov	Applications of agent-based modelling
10	4 Dec	Coding workshop
11	11 Dec	Endnote: thinking big in human history

1.7 Lecturers

The course coordinator and principal teacher is:

Prof. Mark Lake (ML), who is available for consultation in room 115 from 11:00–13:00 on Mondays in Term 1, or by appointment.

Email / Teams calling: mark.lake@ucl.ac.uk

Evolutionary archaeology is taught by:

Prof. Stephen Shennan (SS)
Tel: +44 (0)20 7679 4739
Email

1.8 Weekly module plan

The module is taught through lectures, in-class practical activities (running and coding models) and discussion. Students will be required to undertake set readings and sometimes complete pre-class practical activities in order to be able to actively participate in the discussion.

1.9 Workload

This is a 15-credit module which equates to 150 hours of learning time including session preparation, background reading, and researching and writing your assignments. With that in mind you should expect to organise your time in roughly this way:

- 20 hours staff-led teaching sessions;
- 50 hours self-guided session preparation;
- 40 hours assessment 1;
- 40 hours assessment 2.

2 Assessment

Each assignment and possible approaches to it will be discussed in class, in advance of the submission deadline. If students are unclear about the nature of an assignment, they should discuss this with the module co-ordinator in advance (via office hours or class Moodle forum). You will receive feedback on your written coursework via Moodle, and have the opportunity to discuss your marks and feedback with the co-ordinator in their office hours. For more details see the 'Assessment section on Moodle.

The coursework coversheet is available on the course Moodle pages and here: https://www.ucl.ac.uk/archaeology/current-students under "Policies, Forms and Guidelines". Please make sure you enter your five-digit candidate code on the coversheet and in the subject line when you upload your work in Moodle. Please use your five-digit candidate code as the name of the file you submit.

The IoA marking criteria can be found in the IoA Student Handbook (Section 13: Information on assessment). The IoA Study Skills Guide provides useful guidance on writing different types of assignment.

Please note that **late submission**, **exceeding the maximum word count** and **academic misconduct (unacknowledged use of text generation software and plagiarism)** will be **penalized and can significantly reduce the mark awarded for the assignment and/or overall module result**. Please do consult:

- https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment with sections 13.7–13.8: coursework submission, 13.10: word count, 13.12–14: academic integrity.

- https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity for UCLs guidance on academic integrity.

- https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-AI for UCLs guidance on how to acknowledge the use of text generation software.

The use of software to generate content is not allowed for assessments for this course except in a specific situation where the assessment rubric has asked for it.

The use of software for language and writing review and improvement is permitted, but the software and the way it has been used **must be indicated in the relevant boxes on the coursework coversheet**. UCL defines language and writing review as checking "areas of academic writing such as structure, fluency, presentation, grammar, spelling, punctuation, and language translation".

Assessment 1, Essay. A **2500 word** essay which counts for 50% of your overall module grade. You will be asked to critically evaluate existing archaeological literature covered in the course and its syllabus. A list of questions will be provided for you to choose from. The IoA marking criteria for essays can be found in the IoA Student Handbook (Section 12.2).

Assessment 2, Agent-based model. You will be required to produce an agent-based model in the NetLogo environment. Minimally, this will consist of code, output, and a critical evaluation of your own work through a description that follows the ODD protocol (Grimm et al. 2010 in syllabus). The written component should not exceed **1500 words**. Further instructions and advice will be provided on Moodle and in class, including dedicated assessment criteria. It is **strongly advised that you discuss your model with the Course Coordinator (ML) before you begin this piece of coursework** in order to ensure the scope of the work and criteria for assessment are clear.

3 Resources and preparation for class

3.1 Preparation for class

The practical element of teaching on this course makes heavy use of the NetLogo agent-based modelling environment. You should **install NetLogo on your personal laptop and bring it to lectures**. NetLogo is freely available for most operating systems (MS Windows, MacOS, Linux) and can be downloaded from https://ccl.northwestern.edu/netlogo/. Please contact the Course Coordinator if you will not have access to NetLogo in class.

You are expected to read the essential readings as well as completing any online activities posted on Moodle each week. Completing the readings is essential for your effective participation in the activities and discussions that we will do, and it will greatly enhance your understanding of the material covered. Further readings are provided via the Online Reading List for you to get a sense of the range of current work on a given topic and for you to draw upon for your assessments. The online reading list is accessible through the Moodle page of the module and can be directly accessed here.

3.2 Recommended basic texts and online resources

There is no single textbook that covers the range of material introduced in this course. Please see the essential readings in syllabus below.

4 Syllabus

The following is an outline for the course as a whole. The syllabus identifies essential readings relevant to each session, which are also listed in the course online reading list. The latter also includes suggested supplementary readings.

Week 1: Human history and model-based archaeology (ML)

Following the 'theory wars' of the 1980s and 1990s, contemporary archaeology draws on a wide variety of theory and method. This course focuses on the resurgence of quantitative 'model-based' archaeology, which is to a considerable extent inspired by the theory and methods of complexity science and evolutionary biology, and is seen by many as offering a route to addressing some of 'grand challenges' which it has been suggested that 21st Century archaeology should address. In this first session we discuss some of the grand challenges for archaeology and review the historical and philosophical background to model-based archaeology. A brief sketch of some of the theoretical and methodological sources of inspiration for model-based archaeology serves as a road-map for the course as a whole.

Practical

Brief introduction to the simulation software NetLogo, which will be used to illustrate core concepts throughout the course.

Essential reading

Epstein, J. M. (2008). Why Model? *Journal of Artificial Societies and Social Simulation*, 11/4, 12. [https://www.jasss.org/11/4/12.html]

Kohler, T. A. and van der Leeuw, S. E. (2007). 'Introduction: Historical Socionatural Systems and Models', in Kohler, T. A. and van der Leeuw, S. E. (eds) *The Model-Based Archaeology of Socionatural Systems*. Santa Fe: School for Advanced Research Press, pp. 1–12. [https://sarweb.org/media/files/sar_press_model_based_archaeology.pdf]

Kristiansen, K. (2014). 'Towards a New Paradigm? The Third Science Revolution and Its Possible Consequences in Archaeology', *Current Swedish Archaeology*, 22, pp. 1234. [https://doi.org/10.37718/CSA.2014.01]

Lake, M. W. (2014). 'Trends in Archaeological Simulation', *Journal of Archaeological Method and Theory*, 21/2, pp. 258–287. [https://doi.org/10.1007/s10816-013-9188-1]

Preston, J. (2014). 'Positivist and Post-Positivist Philosophy of Science', in Gardner, A., Lake, M. W. and Sommer, U. (eds) *Oxford Handbook of Archaeological Theory*. Oxford: Oxford University Press. [http://www.oxfordhandbooks.com.libproxy.ucl.ac.uk/view/10.1093/oxfordhb/9780199567942.001.0001/oxfordhb-9780199567942-e-031?rskey=qxhtX2&result=1]

Week 2: Complexity (ML)

Group work A major source of theoretical inspiration for the resurgence of interest in quantitative model-based archaeology is complexity science, which deals with what are more formally called non-linear systems. We will discuss the formal characteristics of non-linear systems and the extent to which they seem to describe aspects of the real world. Of course, much of complexity science was—at least initially—formulated in the natural sciences, so we will consider whether the study of social systems requires additional concepts, particularly around the philosophically challenging and politically contested issues of human agency and multi-level causality.

Practical

Use of NetLogo to explore emergence in ABM and chaos in a dynamical systems model.

Essential reading

Epstein, J. M. and Axtell, R. (1996). *Growing Artificial Societies: Social Science from the Bottom Up*. Washington: Brookings Press and MIT Press. Chapters 1 & 2. [http://cognet.mit.edu.libproxy.ucl.ac.uk/book/growing-artificial-societies]

Gilbert, N. (1995). 'Emergence in Social Simulation', in Gilbert, N. and Conte, R. (eds) *Artificial Societies: The Computer Simulation of Social Life*. London: U.C.L. Press, pp. 144–156. [https://doi.org/10.4324/9780203993699]

Lansing, J. S. (2003). 'Complex Adaptive Systems', *Annual Review of Anthropology*, 32, pp. 183–204. [https://doi.org/10.1146/annurev.anthro.32.061002.093440]

May, R. M. (1976). 'Simple mathematical models with very complicated dynamics', *Nature*, 261, pp. 459–467. [https://doi.org/10.1038/261459a0]

Week 3: Space (ML)

In the last of three sessions exploring the theoretical background to contemporary model-based archaeology we turn to space. First we consider some philosophical / mathematical questions: What is space and how do we 'index' it? How can we describe spatial relations? How can we measure distance? We then discuss Tobler's Law and what makes space special, in the sense that it poses particular challenges for statistical analysis. This leads naturally to an introduction to the concepts underpinning modern spatial statistics, particularly the emphasis on exploring variability at different spatial scales (rather than just one), the homogeneity or otherwise of observed patterns and relationships across a study area and the recognition that spatial patterns may be caused by external factors of a wider environment' and/or internal interactions within the pattern of interest. The third major theme for this session is the rapid growth of network science, which extends the reach of formal quantitative analysis to relations between entities that are not easily conceived in terms of their extent or position on a continuous two-dimensional plane (or three dimensional volume).

Practical work

Introduction to different kinds of substrate-neutral network and some statistical measures of their properties.

Essential reading

Bevan, A. and Lake, M. (2013). 'Introduction', in Bevan, A. and Lake, M. (eds) *Computational Approaches to Archaeological Spaces*. Walnut Creek, CA: Left Coast Press, pp. 1–10. [https://doi-org.libproxy.ucl.ac.uk/10.4324/9781315431932]

Bevan, A., Crema, E., Li, X. and Palmisano, A. (2013). 'Intensities, Interactions, and Uncertainties: Some New Approaches to Archaeological Distributions', in Bevan, A. and Lake, M. (eds) *Computational Approaches to Archaeological Spaces*. Walnut Creek, CA: Left Coast Press, pp. 27–52. [https://doi-org.libproxy.ucl.ac.uk/10.4324/9781315431932]

Collar, A., Coward, F., Brughmans, T. and Mills, B.J. (2015). 'Networks in Archaeology: Phenomena, Abstraction, Representation', *Journal of Archaeological Method and Theory*, 22, pp. 1-32. [https://doi.org/10.1007/s10816-014-9235-6]

Watts, D. J. & Strogatz, S. H. (1998). 'Collective Dynamics of 'Small-World' Networks', *Nature*, 393, pp. 440-442. [https://doi.org/10.1038/30918]

Week 4: Human Behavioural Ecology (SS)

This session is the first of three which work through the application to concepts and methods from evolution biology to archaeological and anthropological questions. Human Behavioural Ecology is an approach to the understanding of human behaviour based on assessing the costs and benefits of particular courses of action in specific circumstances in terms of natural selection, in other words their contribution to survival or reproductive success. The best known sub-field is optimal foraging theory, which provides a basis for predicting resource exploitation patterns under the assumption that they optimise the rate of return in a given context. However, HBE is relevant to many if not most areas of human social and economic life.

Essential reading

Codding, B.F. and Bird, D. W. (2015). 'Behavioral ecology and the future of archaeological science', *Journal of Archaeological Science*, 56, pp. 9–20. [https://doi.org/10.1016/j.jas.2015.02.027]

Page, A. E., et al (2016). 'Reproductive trade-offs in extant hunter-gatherers suggest adaptive mechanism for the Neolithic expansion', *PNAS*, 13, pp. 4694–4699. [https://doi.org/10.1073/pnas.1524031113]

Mattison, S., et al (2016), 'The evolution of inequality', *Evolutionary Anthropology*, 25, pp. 184–199. [https://doi.org/10.1002/evan.21491]

Week 5: Cultural Evolution and Niche Construction (SS)

Darwinian cultural evolution starts from the assumption that humans have two inheritance systems, the genetic one common to all the living world, and culture, generally defined as socially transmitted information. It is Darwinian because it is governed by variation, selection and inheritance processes. In cultural evolution, or dual inheritance, models a major role is attached to the process of cultural transmission, and the forces that act on it, and not simply to cost-benefit distributions. Niche construction refers to the idea that organisms in general (not just people)

change their environments over time so that subsequent generations face new selection pressures and have to adapt accordingly. In other words, it is not just genes and culture that are modified and transmitted but environments (meant in the broadest sense) as well.

Essential reading

Boyd, R., et al (2011). 'The cultural niche: Why social learning is essential for human adaptation', *PNAS*, 108, pp. 10918–10925. [https://doi.org/10.1073/pnas.1100290108]

Mesoudi, A. (2015). 'Cultural Evolution: A Review of Theory, Findings and Controversies', *Evolutionary Biology*. [https://doi.org/10.1007/s11692-015-9320-0]

Riede, F. (2019). 'Niche construction theory and human biocultural evolution', in Prentiss, A. M. (ed.) *Handbook of Evolutionary Research in Archaeology*. Springer, pp. 337–358. [INST ARCH BB 1 PRE]

Shennan, S. (2012). 'Darwinian cultural evolution', in Hodder, I. (ed.) *Archaeological Theory Today* (2nd edition), pp. 15–36. [https://ucl-new-primo.hosted.exlibrisgroup.com/permalink/f/1klfcc3/TN_cdi_askewsholts_vlebooks_9780745681009]

Week 7: Macroevolution, phylogenetics and the comparative method (SS)

As the name indicates, macroevolution refers to the evolution of large-scale patterns, for example the origin of species in biology or of languages or cultures. The key process in macroevolution is phylogenesis, or evolutionary diversification, in which successive mutations or innovations lead to the splitting off of new branches on an evolutionary tree. The methods of computational phylogenetics have been developed to reconstruct the evolutionary trees of relationships between, for example, languages and between different archaeological types such as projectile points, but there has been a great deal of debate about whether such trees are an appropriate representation of cultural relationships. Regardless of this, if we are trying to test adaptive hypotheses of the kind that behavioural ecologists are interested in, for example that societies where cattle-keeping is important are more likely to emphasise patrilineal than matrilineal descent (Holden and Mace 2003), then we need to be able to distinguish societies where patriliny and cattle-keeping are found together because they share a common ancestor where the two co-occur, from those where they co-occur because of some selective pressure that leads one to benefit the other. Addressing this sort of problem has led to the development of the phylogenetically-controlled comparative method, a set of statistical techniques for distinguishing the effects of descent from adaptation.

Essential reading

Gray, R. D. and Watts, J. (2017). 'Cultural macroevolution matters', *Proceedings of the National Academy of Sciences*, Jul 2017, 201620746. [https://doi.org/10.1073/pnas.1620746114]

Mace, R., Pagel, M. (1994). 'The comparative method in anthropology', *Current Anthropology*, 35, pp. 549–564. [https://doi.org/10.1086/204317]

Prentiss, A. M., et al (2015). 'Cultural macroevolution among high latitude hunter gatherers: a phylogenetic study of the Arctic Small Tool tradition', *Journal of Archaeological Science*, 59, pp. 64–79. [https://doi.org/10.1016/j.jas.2015.04.009]

Straffon, L.M. (2019). 'The uses of cultural phylogenetics in archaeology', in Prentiss, A. M. (ed.) *Handbook of Evolutionary Research in Archaeology*. Springer, pp. 149–160. [INST ARCH BB 1 PRE]

Week 8: Agent-based modelling (ML)

This is first of three sessions which focus on agent-based modelling. We will look in more detail at what makes up an agent-based model and consider explore two very different archaeological examples, *Artificial Anasazi* and *HModel*. We will also revisit the idea of generative social science and discuss how the use of models as experimental laboratories supports archaeological inference.

Practical

Exploration of the NetLogo models *Artificial Anasazi* and *HModel*

Essential reading

Axtell, R. L., Epstein, J. M., Dean, J. S., Gumerman, G. J., Swedlund, A. C., Harburger, J., Chakravarty, S., Hammond, R., Parker, J. & Parker, M. (2002). 'Population Growth and Collapse in a Multiagent Model of the Kayenta Anasazi in Long House Valley', *Proceedings of the National Academy of Sciences of the United States of America*, 99 (Suppl 3), pp. 7275–79. [https://doi.org/10.1073/pnas.092080799]

Janssen, M. A. (2009). 'Understanding Artificial Anasazi', *Journal of Artificial Societies and Social Simulation*, 12/4, p. 13. [http://jasss.soc.surrey.ac.uk/12/4/13.html]

Davies, B., Holdaway, S. J., & Fanning, P. C. (2016). 'Modelling the Palimpsest: An Exploratory Agent-Based Model of Surface Archaeological Deposit Formation in a Fluvial Arid Australian Landscape', *The Holocene*, 26/3, pp. 450–63. [https://doi.org/10.1177/0959683615609754] [Code at https://www.comses.net/codebases/5906/releases/1.0.0/]

Lake, M. (2015). 'Explaining the Past with ABM: On Modelling Philosophy', in Wurzer, G., Kowarik, K. and Reschreiter, H. (eds) *Agent-Based Modeling and Archaeology*. Switzerland: Springer, pp. 3–35. [https://doi.org/10.1007/978-3-319-00008-4_1]

Lake, M. (2020). 'Spatial Agent-Based Modelling', in Gillings, M., Hacgüzeller, P. and Lock, G. (eds) *Archaeological Spatial Analysis*. Taylor & Francis, pp. 247272. [https://doi-org.libproxy.ucl.ac.uk/10.4324/9781351243858]

Week 9: Applications of agent-based modelling (ML)

This second session on agent-based modelling will further discuss the diversity of models used in archaeology. You will start learning to programme models in NetLogo.

Practical

Introduction to programming your own model in NetLogo.

Essential reading

Cegielski, W. H., & J. D. Rogers. (2016). 'Rethinking the Role of Agent-Based Modeling in Archaeology', *Journal of Anthropological Archaeology*, 41, pp. 28398. [https://doi.org/10.1016/j.jaa.2016.01.009]

Lake, M. W. (2014). 'Trends in Archaeological Simulation', *Journal of Archaeological Method and Theory*, 21/2, pp. 258–287. [https://doi.org/10.1007/s10816-013-9188-1]

Romanowska, I., Wren, C. and Crabtree, S. (2021). *Agent-Based Modelling for Archaeology: Simulating the Complexity of Societies*. Santa Fe, NM: Santa Fe Press. [https://santafe.app.box.com/s/64tasmxpsrhdq5dwjyromtrk4c9lmsv4?utm_source=santafeedu&utm_medium=website&utm_id=pdf_download] [Code at https://github.com/SantaFeInstitute/ABMA] Chapter 1.

Week 10: Code workshop (ML)

This session is set aside to provide further support for writing your own agent-based model. I will determine the exact format nearer to the time to take account of your progress.

Practical

Programming in NetLogo.

Essential reading

Grimm, V., Berger, U., DeAngelis, D. L., Polhill, J. G., Giske, J. and Railsback, S. F. (2010). 'The ODD Protocol: A Review and First Update', *Ecological Modelling*, 221, pp. 2760–68. [https://doi.org/10.1016/j.ecolmodel.2010.08.019]

Romanowska, I., Wren, C. & Crabtree, S. (2021). *Agent-Based Modelling for Archaeology: Simulating the Complexity of Societies*. Santa Fe, NM: Santa Fe Press. [https://santafe.app.box.com/s/64tasmxpsrhdq5dwjyromtrk4c9lmsv4?utm_source=santafeedu&utm_medium=website&utm_id=pdf_download] [Code at https://github.com/SantaFeInstitute/ABMA]

Week 11: Human history and qualitative change (ML)

We consider the ideas of 'big' history and 'deep' history and then consider what counts as qualitative change in long-term human history. The notion of a tipping point is perhaps the most widely invoked of all the concepts of complexity science. We hear of tipping points in, for example, climate change, responses to immigration and global capital-flows, but what, formally speaking is a tipping point? In this session we focus on irreversibility, discontinuity and systemic brittleness, and introduce the concept of a parameter space (or phase space), which can help us map qualitative change in quantifiable systems. Possible tipping points in the domain of archaeology and anthropology include the major transitions in evolution, the collapse of complex societies, the extinction of hunted species and the onset of the anthropocene.

Practical

Use of NetLogo to examine tipping points and bifurcation.

Essential reading

Bentley, R. A. and O'Brien, M. J. (2012). 'Cultural Evolutionary Tipping Points in the Storage and Transmission of Information', *Frontiers in Psychology*, 3, article 569. [https://doi.org/10.3389/fpsyg.2012.00569]

Lewis, S. L. and Maslin, M. A. (2015). 'Defining the Anthropocene', *Nature*, 519/7542, pp. 171–180. [https://doi.org/10.1038/nature14258]

Smith, M. (1992). 'Braudel's Temporal Rhythms and Chronology Theory', in Knapp, A. B. (ed.) *Archaeology, Annales and Ethnohistory*. Cambridge: Cambridge University Press, pp. 22–34. [https://ucl-new-primo.hosted.exlibrisgroup.com/permalink/f/1klfcc3/TN_cdi_cambridge_cbo_9780511759949_xml_CBO9780511759949A011]

Sherratt, A. (1995). 'Reviving the Grand Narrative: Archaeology and Long-Term Change', *Journal of European Archaeology*, 3, pp. 132) [https://doi.org/10.1179/096576695800688223]

Turchin, P. & Nefedov, S. A. (2009). *Secular Cycles*. Princeton: Princeton University Press. Chapter 1. [http://www.jstor.org/stable/j.ctt7t2gj.4]